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Title: Modeling and acquisition of plant architecture

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Abstract.
Virtual plant models are powerful tools to better understand growth and functioning of plants and their interaction with their environment (light, pest and disease propagation, etc). However, numerous problems are raised for their acquisition, representation, analysis and simulation. We have been developing for several years a modeling methodology of the structure and geometry of plants that makes it possible to take into account their multi-scale aspect and exploit it for acquisition. In this talk, I will present our recent works on the acquisition of complex plant architectures. In the first part, I will introduce sketching based methods and present the approach we developed based on the structure from silhouettes paradigm. Indeed, we claim and show with our prototype that sketching the silhouettes of foliage at multiple scales is quicker and more intuitive for a user than having to sketch each branch of a tree. This choice allows us to incorporate botanical knowledge, enabling us to infer branches that connect in a plausible way to their parent branch and have a correct distribution in 3D. Users have to give the outlines of the different parts of the tree and an example of structures at each scale to make it possible for the program to generate a complete structure that the user can finally correct easily. While this makes it possible to define intuitively plausible virtual models in few minutes, we also address the problem of reconstructing faithfully actual plant architectures. Using laser scanners is a natural way to capture such complex, real geometry; however, due to the multi-resolution nature of trees, it produces data at different levels of precision. Points set are usually dense on the surface of the trunk and of the main branches, but only sparsely cover thin branches and small twigs. While previous methods typically loose accuracy by populating sparse-points regions with plausible structures, we propose a faithful reconstruction method of the tree skeletal structure. This is achieved thanks to a method locally adaptive to the different levels of precision of the data that combines a contraction phase and a local point tracking algorithm. In addition, we developed a quantitative evaluation procedure enabling us to compare our reconstructions against expertised structures of real plants. We used it to assess the accuracy of our reconstruction algorithm.

Key Words: Plant Architecture, Virtual model, Reconstruction, Sketching, Laser Scanner